LOCAL HAZARD MITIGATION PLAN ANNEX
San Francisco Bay Area Rapid Transit District (BART)

Introduction

The San Francisco Bay Area Rapid Transit District (BART) is a State of California special district created by the State Legislature in 1957. A board of nine publicly elected directors governs the District.

BART is one of the San Francisco Bay Area's most vital transportation links, carrying an average of 310,000 passenger trips every weekday. The system consists of 104 miles of revenue track and 43 stations. BART employs more than 3300 workers with an annual operating budget of $475M.

The Planning Process

BART understands that there are many hazards in its service territory that need to be mitigated. Hazards and environmental impacts are addressed for new construction through studies that are required pursuant to BART's Facility Standards. BART has an existing program, the Earthquake Safety Program, to identify seismic risks and to develop mitigation strategies for the existing BART system. BART recognizes that no system can be made damage or disaster proof, and has an Emergency Plan to address response to natural and man-made disasters/emergencies including earthquakes, fire, flooding, hazardous materials and explosions. The Emergency Plan was prepared by BART's System Safety Department and was last revised in November 2002. BART also has a Terrorism Response Plan and associated supplements in place. The Terrorism Response Plan is controlled by BART Police.

BART was involved in the development of ABAG's Multi-Jurisdictional Local Government Hazard Mitigation Plan. BART participated in workshops and meetings, including the general "kick-off" meeting, and provided written and oral comments on the multi-jurisdictional plan.

BART has had many meetings associated with identification and mitigation of hazards. Meetings held include seismic mitigation of the existing system as part of the Earthquake Safety Program (criteria, performance goals, funding strategies, etc.), developing designs to mitigate fault movement across the alignment for the new Warm Springs Extension Project, and understanding and designing for 100-year and 500-year floods along the alignment for the Silicon Valley Rapid Transit Project. Several meeting were also held to discuss the BART mitigation strategies in this Annex. Input and decisions on hazard mitigation involve many people on various levels with diverse functions, including the General Manager and the BART Board.

Except for two items, all of the mitigation strategies in BART's Annex can be classified as "Existing Programs" or "Not Applicable, Not Appropriate, or Not Cost Effective." This demonstrates that BART is being pro-active in addressing hazards. Two items are

identified as "High Priority." Applications for PDM-C grants have been submitted for these two items.

Hazard and Risk Assessment

The ABAG Multi-Jurisdictional Local Government Hazard Mitigation Plan, to which this is an Annex, lists nine hazards that impact the Bay Area, five related to earthquakes (faulting, shaking, earthquake-induced landslides, liquefaction, and tsunamis) and four related to weather (flooding, landslides, wildfires, and drought).

Drought does not impact BART. Drought will not have any impact on the safety or function of the BART system. If drought conditions were to occur, BART would curtail use of water for such purposes as washing trains.

BART has a number of existing programs and strategies to address hazards. BART's goals are as follows: 1) to understand risks and hazards associated with existing and new construction; 2) to ensure the safety of passengers and employees; and 3) to minimize disruption of service following catastrophic events. The objective of the programs and strategies is to provide a cost effective level of design or retrofit consistent with the importance/function of each specific facility and the consequences of damage. Consequences of damage that are considered include life safety, the disruption of service, impact on the Bay Area economy and capital losses.

The most significant BART hazard mitigation program currently in place is the Earthquake Safety Program. In 2000, BART hired a team of consultants led by Bechtel Infrastructure and HNTB to evaluate all of the facilities and components in the BART system. The original system, consisting of 34 stations and 74 miles of track, was designed to criteria that were considered conservative at the time. However, lessons learned from subsequent earthquakes, including more knowledge about seismicity and behavior of structures, led BART to believe that the system had vulnerabilities that needed to be mitigated. The evaluation contained in the BART Seismic Risk Analysis Report and BART Systemwide Seismic Vulnerability Study Report confirmed that the system and specific facilities/components in the original system were vulnerable to damage that have life safety and significant operability impacts. It was assessed that major portions of the BART system could be out of service for at least two years.

Earthquake scenario studies, including the San Andreas magnitude 8.0 and the Hayward magnitude 7.0 were used to assess the impact of likely earthquakes on life safety and operability of the system, and to develop cost/benefit of various retrofit packages. It is not practical or economically feasible to retrofit to a damage proof level, and focused emergency response, inspection and repair plans/procedures will be developed to help expedite restoration of service.

BART convened an independent Peer Review Panel (PRP) to review the seismic evaluations, design criteria and retrofit concepts to help ensure that they were technically sound, economically prudent, and responsive to system operational goals. The retrofit

schemes/design use site specific geotechnical and ground motion information developed for the project. Environmental evaluations, coordination with agencies associated with the Bay, and hazardous material surveys are being conducted to ensure that potential environmental impacts are addressed.

Due to the concern about the impact of future earthquakes on the BART system, funding was sought and obtained through a combination of sources including Caltrans Local Seismic Safety Program ($134M for aerial structures), Regional Measure 2 ($143M through toll bridge increases to be contributed toward the Transbay Tube retrofit), and a general obligation bond passed in November 2004 ($980M). BART's contribution for the $1.307B retrofit package, consisting of retrofitting to achieve operability of the Core of the system (from the Berkeley Hills tunnel to Daly City) and life safety for the remainder of the system is $50M. The method of raising BART's contribution has yet to be determined. In addition to the $50M required for Core operability, BART is trying to find additional funds (estimated to be $300M) to allow operability retrofits to essential facilities/components outside the Core.

On new projects, hazards are assessed using strategies and procedures that include numerous project specific/site specific hazard and environmental studies and reports. Some of the studies include the following: 1) Ground motion studies are performed to develop design response spectra, location and potential movement at faults, and other ground motion data; 2) Geotechnical studies and borings are performed to determine landslide, liquefaction and lateral spreading potential, design loads for foundations, and other geotechnical data; 3) Studies are performed to ensure against environmental impacts including all CEQA and NEPA required studies and reports, and hazardous material assessments; and 4) Surface water hydrology and hydraulic studies are done to assess the impact and needed mitigation for potential flooding. Studies and reports that are required are specified in the BART Facility Standards.

The risks due to the hazards can be observed by overlaying the BART system onto ABAG's various hazard maps. The entire BART system including 104 miles of track, 43 stations, and 73 essential buildings/facilities were reviewed using the ABAG website:

- Fault Surface Rupture - The BART alignment crosses faults designated as active by the State Geologist at several locations including: the Berkeley Hills Tunnel, two aerial crossings on the Concord Line, one at-grade crossing on the Concord Line and one at-grade crossing on the Dublin Pleasanton Line (Plate 1). Additional faults in the eastern Contra Costa have been recently been identified, and BART is in the process of evaluating them.
- Shaking - 95 miles of trackways, 40 stations and 63 essential buildings/facilities are in the highest categories of shaking potential (Plate 2).
- Liquefaction - 48 miles of trackways, 20 stations and 32 essential buildings/facilities are in areas of moderate, high or very high liquefaction susceptibility (Plate 3).
- Earthquake-Induced Landslides – 2 miles of trackways in Alameda County are in areas mapped as exposed to earthquake-induced landslides. However, all of the trackways in Contra Costa County and 6 miles of trackways in Alameda County have yet to be mapped or evaluated by the California Geological Survey. Given this lack

of consistent hazard information, no specific analysis is seen as appropriate other than that for the traditional storm-induced landslide hazard. BART supports the CGS effort to complete this mapping (see Mitigation Strategy LAND-a-4).

- Tsunamis – None of the BART trackways or facilities are currently in tsunami evacuation planning areas. However, the mapping has not been completed. It is possible that the facilities near San Francisco Bay will be mapped as being in these areas in the future.
- Flooding - 2 miles of trackways, 1 station (South San Francisco) and 0 essential buildings/facilities are in the 100-year flood plain (Plate 4).
- Landslides - 4 miles of trackways, 0 stations and 2 essential buildings/facilities (a radio tower and breaker station in Dublin) are in areas of existing landslides (Plate 5).
- Wildfire - 9 miles of trackways, 0 stations and 7 essential buildings/facilities are indicated on the ABAG maps as being in high, very high, or extreme wildfire threat areas (Plate 6), while 44 miles of trackways, 15 stations and 33 essential buildings/facilities are in wildland-urban interface threat areas (Plate 7).
- Dam Failure Inundation Areas - 19 miles of trackways, 8 stations and 13 essential buildings/facilities are in areas subject to dam inundation (Plate 8).

The occurrence of previous disasters associated with earthquakes (strong shaking, fault rupture, landslides, liquefaction) and weather (flooding, landslides, wildfire, and drought), and the probabilities of future occurrences are given in Appendix D "Disaster History" and Appendix C "Natural Hazards Risk Assessment" of the Multi-Jurisdictional Local Government Hazard Mitigation Plan. A disaster caused by dam failure has not occurred in the Bay Area and is very unlikely to occur, especially with the efforts being made by dam owners to evaluate and mitigate potential risks.

The information in the ABAG website on strong shaking, landslides and liquefaction was known to BART through studies in conjunction with the Earthquake Safety Program and studies performed prior to construction of many of BART's stations and components. Recent geotechnical investigations in eastern Contra Costa (Contra Costa Shear Zone) identify more locations of potential fault displacements on the Concord Line than indicated on the ABAG website. BART hired a consultant to locate specific fault locations and anticipated creep and coseismic slip. The Earthquake Safety Program will address and mitigate vulnerabilities associated with strong shaking, fault displacement, landslides and liquefaction.

Flood plains and projected water levels were anticipated in initial BART design and construction, and are not considered a significant hazard. As an example, a study for the four-station extension to San Francisco International Airport identified that water levels from a 100-year storm in Colma Creek through South San Francisco could potentially flood a new underground station. As a result, the station entrance was raised and the capacity of local flood control structures (i.e., Colma Creek and its tributaries) was increased. BART performed similar drainage work throughout the SFO Extension.

There are eight stations in the ABAG flood plain areas caused by potential dam failure. ABAG will work with the dam owners to assess the vulnerability of their dams and to

implement mitigation steps, if required. Many of the dam owners are already actively assessing the vulnerability of their dams. Review of the eight BART stations indicate that if dam failure were to occur, the impact on the ability to restore service would probably not be significant.

There is approximately 53 miles of BART trackway shown in the ABAG map that indicates potential danger from wildfire or are in wildland urban interface areas. In the worst of these areas, the Oakland hills and the California State Highway 24 corridor, BART is either in tunnel or in the median of an 8-lane freeway, which provides a buffer from the nearby timber and grass fuel source area. BART service was interrupted for only a short period (less than 24 hours) for replacement of a short stretch of kinked rails during the worst urban wildfire in the Bay Area history, the Oakland Hills fire of 1991. The District also has an ongoing weed abatement program for at-grade sections of trackway.

In conclusion, earthquakes are the predominate hazard impacting BART facilities. BART has generated estimates of potential dollar losses due to four earthquake scenarios. Estimates of direct capital losses to overhead and at-grade trackways, the Transbay Tube, the Berkeley Hills tunnel, stations, buildings, systems and equipment due to faulting, shaking, liquefaction, and landslides are provided below[1]. Damage to specific components, and loss by type of component was also determined.

- Hayward – Magnitude 7 - $1.1B
- San Andreas – Magnitude 8 - $860M
- Calaveras – Magnitude 6.8 - $260M
- Concord – Magnitude 6.8 - $250M

Expected losses due to the weather-related hazards are relatively minor in comparison because of existing efforts to mitigate the hazards, as explained above and in the following section.

Mitigation Activities and Priorities

As a participant in the ABAG multi-jurisdictional planning process, BART staff helped in the development and review of the comprehensive list of mitigation strategies in the overall multi-jurisdictional plan. The priorities for BART and specific mitigation strategies were discussed at meetings that included, at various times, the Chief Engineer, the Chief Safety Officer, Earthquake Safety Program staff, Transit System Development personnel, Maintenance and Engineering personnel, the General Manager, the Deputy General Manager, and members of the BART Board of Directors. BART is committed to continue to develop project specific hazard and risk information to make appropriate decisions on mitigating hazards.

As noted in the attached list of Mitigation Strategies, many strategies are existing programs and are already a part of the planning process. BART has requirements in its

[1] BART Seismic Vulnerability Study, 2002.

Facilities Standards that require identification and mitigation of hazards, as well as compliance with applicable building and fire codes, and environmental regulations. Thus, BART has been extremely successful in incorporating these mitigation strategies into existing planning mechanisms. Except for two items, all of the mitigation strategies in this Annex can be classified as "Existing Programs" or "Not Applicable, Not Appropriate, or Not Cost Effective." This demonstrates that BART is being pro-active in addressing hazards. Two items are identified as "High Priority." Applications for PDM-C grants have been submitted for these two items.

BART uses a variety of planning and project-specific mechanisms to ensure that the projects and mitigation strategies identified as existing or having relatively high priorities in this Annex are implemented. For example:

- The vegetation-clearing program around facilities and trackways is funded from BART operations and maintenance funds that come from BART fares and sales taxes.
- The Earthquake Safety Program is funded from a number of sources as described above. The program is currently under funded for the performance goal of operability of the entire system. It is possible that additional required funding will come from other sources, including future fare increases and from FEMA Pre-Disaster Mitigation Grants.
- New projects such as the southern extension to San Jose are funded by a number of sources such as State and, possibly, Federal Grants, Bond Measures, sales taxes, etc. The first expenditures on these projects include investigations and reports that assess risks, hazards and environmental impacts.

BART determined that the potential risks and impacts to BART and the Bay Area economy from earthquake damage to the Train Operations Center (TOC) was significant, and BART has applied for a Pre-Disaster Mitigation grant to mitigate the impact of earthquakes to this complex. BART's General Manager and Board of Directors approved the mitigation strategy associated with this complex. BART also owns 23.76% of the MetroCenter, which houses ABAG, MTC and BART offices and essential functions. BART has joined with ABAG and MTC to apply for a Pre-Disaster Mitigation Grant for this building (with MTC taking the lead).

BART's Local Hazard Mitigation Plan was presented to the Deputy General Manager and General Manager for their review. Thereafter, the Local Hazard and Mitigation Plan was presented to the BART Board of Directors and adopted during the April 14, 2005 BART Board Meeting.

The Plan Maintenance and Update Process

BART Maintenance and Engineering will ensure that ***monitoring*** of this Annex will occur. The plan will be monitored on an on-going basis. However, major disasters affecting the Bay Area, legal changes, new hazard maps, notices from ABAG as the lead agency in this process, and other triggers will also be used. Finally, the Annex will be discussed and reviewed with the Chief Engineer at least once a year. At that meeting, the focus will be on ***evaluating*** the Annex in light of technological, regulatory and BART

system changes during the past year or other significant events. BART Maintenance and Engineering will be responsible for determining if the plan should be updated.

BART is committed to reviewing and updating this Annex at least once every five years, as required by the Disaster Mitigation Act of 2000. BART's Chief Engineer will contact ABAG four years after this plan is approved to ensure that ABAG plans to undertake the plan update process. If so, BART again plans to participate in the multi-jurisdictional plan.

The public will continue to be involved in disaster mitigation, including whenever the plan is updated and, as appropriate, during the monitoring and evaluation process. For example, this plan and proposed changes will be provided to the BART Board of Directors in public meetings. In addition, BART has established the Citizens Oversight Committee for the Earthquake Safety Program. Finally, BART holds many Stakeholder Meetings in conjunction with the Earthquake Safety Program and other projects to discuss changes affecting service and facilities. All public comments will be reviewed. Publicly initiated changes will be integrated into the plan updates whenever reasonable and appropriate.